

## Flower Morphology of *Sasa jotanii* (Poaceae: Bambusoideae); New Taxonomic Status

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Flowers of *Sasa jotanii* (Poaceae: Bambusoideae) from Isl. Mikurajima, Izu Islands, Japan, are observed on the basis of new flower characteristics and a new specific status of it is proposed here. Comparing the species with the most related allies, *S. kurilensis* and *S. tsuboiana*, *S. jotanii* is characterized by a large fusiform, incanus reddish-purple spikelet 25–36 (–40) mm long, 7–12 mm wide, extremely large elliptic non-dormant caryopsis (14.5–) 17–21.5 mm long in reproductive organs; its less decumbent culms, coriaceous and waxy foliage leaves, and lanceolate leaf blade without oral setae and sheath-margin fimbriae in sterile organs. *Sasa jotanii* is probably most closely related to *S. kurilensis* belonging to the section *Macrochlamys*.

**Key words:** Bambusoideae, flower morphology, Mikurajima Island, *Sasa jotanii*, *Sasa kurilensis*

*Sasa kurilensis* (Rupr.) Makino & Shibata var. *jotanii* Ke.Inoue & Tanimoto from Isls. Mikurajima and Hachijojima, Izu Islands, Japan is distinguished by its thicker foliage leaves and less decumbent culm from *S. kurilensis*. The plant was called invalidly as *S. mikurensis* Nakai for a sterile specimen collected by Jotanii (1935) from Isl. Mikurajima. After the Tanimoto's discovery of the distribution of the plant in Hachijojima (Tanimoto et al. 1983), Kobayashi (1985) reported on the morphological characteristics and ecology of the plant on Mikurajima and Hachijojima Islands in detail and confirmed that they can certainly be referred to *Sasa kurilensis*. However, Suzuki (1996) treated the plant as a synonym of *Sasa tsuboiana* Makino.

In the spring of 1997, a monocarpic mass flowering occurred on Isl. Mikurajima

(Tanimoto and Kobayashi 1998). Since then, morphology of flower and caryopsis, rhizome development, and the population recovery process have been intensively investigated (Nishiwaki and Makita 1998, Muramatsu 1998, Kobayashi and Tanimoto 1999). Detailed examination on flower morphology revealed that the plant is not a variety of *S. kurilensis*, but a distinct species of the genus *Sasa* section *Macrochlamys*. Here I propose a new taxonomic status as a species of genus *Sasa*.

### Materials and Methods

Flower specimens of *S. jotanii* were collected on April 2, 1997 on Mt. Oyama at alt. 850 m near the summit (Kobayashi 1587) and alt. 680 m below Suzuhara Moor (Kobayashi 1588) in Isl. Mikurajima, Izu Islands, Japan. Measures of each floral part

showed the ranges of 8 matured florets which developed anthers longer than 9 mm. Flower data on *S. kurilensis* and *S. tsuboiana* were referred to Takagi (1963). Specimens of caryopses of *S. jotanii* and *S. kurilensis* and their size data were provided by A. Nishiwaki. Dry specimens of *S. kurilensis* (A. Makita; Sept. 24, 1980 at Mt. Akakura in Mts. Hakkoda) and *S. tsuboiana* (A. Makita; Jul. 6, 1982 at the summit of Houraisen, Mt. Hyonosen) were investigated in which each 30 spikelets and the pedicels were measured for the size and length. Voucher specimens of flowering culms (M. Kobayashi 1587, 1588) were deposited in the herbaria of the University of Tokyo (TI), the Tokyo University of Agriculture (TUA), and Faculty of Agriculture, Utsunomiya University, in which the last herbarium other specimens were also deposited.

Additional specimens examined for the diagnostic features on the sterile organs were as follows; Mikurajima Island, Mt. Oyama: Jun. 24, 1984, K. Inoue (TUA 77871): holotype; Jun. 24, 1984, T. Tanimoto (TUA 77875); Jun. 24, 1984, K. Inoue (TUA 77869); Jul. 28, 1967, S. Hayama et al. (TUA 65383) and Jul. 29, 1934, Y. Jotani (TI): isotype; Oct. 6, 1963, N. Satomi; Dec. 22, 1984, M. Kobayashi 117; Jul. 24, 1985, M. Kobayashi 158. Hachijojima Island, Mt. Miharayama: Dec. 1982, T. Tanimoto (TUA 79389) and Jan. 1983, T. Tanimoto (TUA): isotype; Dec. 19, 1984, M. Kobayashi 115; Oct. 29, 1999, M. Kobayashi 1651, 1655, 1659.

### Observation

Inflorescence determinative, resulting in a short leafless branch 8–12 cm long with a small panicle 4–6 cm long, the branch emerged from subtending, glabrous culm-sheaths, the pedicels villosus with brownish hairs, 5–15 mm long, subtended by an acuminate villose bract at the base. Spikelets fusiform, whitish purple, 25–36 (–

40) mm long, usually 4-flowered, the lowest floret longest and most complete, the uppermost smallest and aborted, each separated by a narrow rachilla segment, dilated upward. Glumes 2, villosus with brownish white hairs, ciliate on the margins, obtuse-acuminate, glume I shorter than glume II, the latter  $4/5$  as long as the lemma; glume I 5.5–9.5 (–12.9) mm long, ovate-lanceolate, 5-nerved with several transverse veinlets; glume II (10–) 13–22.5 mm long, the same shape as the first but longer, 13-nerved, ciliate on the upper margin. Lemma of lowermost floret (13–) 17.5–22 (–24) mm long, ovate with an acute-apiculate apex 5–7 mm long, 13-nerved, hoary or incanus on the upper surface on the intercostal zones, ciliate on the margins; palea elliptic, incanus on the upper surface on the intercostal zones, ciliate on the margins, a little shorter than the lemma, 2-keeled, ciliate on the upper  $1/4$  of the keels, the keels broadly winged and enveloping the flower, nerves with transverse veinlets, 5 between the keels, 4 in each wing; mucronate at the apex; lodicules 3, the 2 anterior more or less obovate with a broad, slightly acute apex, 3–4 (–4.5) mm long, upper  $1/3$  pubescent with ciliated margins, the lodicules fleshy at one or both ends of the basal part and contain many nerves, the posterior lodicule a single thin, many-nerved membrane, obovate with an acute apex, 2.0–2.6 (–3.0) mm long, glabrous except for the ciliate upper margin; androecium stamens 6, the filaments long, filiform, free, basifixed, attached to the filaments on the lower  $1/6$ ; the anthers red, 9.2–10.5 mm long; gynoecium ovary glabrous with 3 plumose and spiral stigmas. Fruit an elliptic caryopsis (14.5–) 17–21.5 mm long, glabrous except for a pubescent nipple at the summit, the embryo basal,  $1/7$  the length of the fruit, the hilum linear, extending the entire length of the caryopsis in a furrow on the slightly convex side.

Plants of diffused clump habit from

amphipodial amphimorph rhizomes. Culms strong, cylindrical, hollow, ascending, up to (0.6–) 1.5–2.5 m tall, (5.5–) 11.0–12.5 (–19.0) mm in diam. with a white waxy ring at the summit of the internode, branching at upper nodes. New and old culms waxy, green, glabrous. Culm-sheaths creamy white, glabrous, becoming stramineous with age, waxy and leathery, blade erect at first, becoming horizontal or reflected, lately abscissile, linear-lanceolate, sheath-margin fimbriae absent. Nodes containing a single branch bud, branching intravaginal. Foliage leaves aggregated at the top of branch, in complements 15–30 cm long, 30 cm wide, with 7–10 leaves in the complement; blades narrowed abruptly at the base and lanceolate, narrowed to an acuminate tip, most fully developed blades (17–) 23–26 (–29) cm long, 3–4 (–4.3) cm wide, glabrous; sheath somewhat compressed, glabrous; fimbriae on the

sheath-margins absent; inner ligule a deltoid membrane 3 mm long with a denticulate margin, glabrous on both surfaces; outer ligule short truncate, hard, glabrous.

Phenology. Mass flowering occurred from the lower distribution limit at alt. 590 towards the summit of Mt. Oyama, when the time of flowering in full bloom was at the mid March, 1997 and terminated at the early April. Partial flowering occurred in each year of 1996 and 1998. Caryopses germinated without dormancy, immediately after the maturation at early to mid June, 1997. The period of flowering cycle in *S. jotanii* was estimated as 60 years, because an 80-year-old villager remembered that the last flowering had occurred on the year at his 20-year-old of 1937 (Tanimoto and Kobayashi 1998).



Fig. 1. Photograph of flowering panicle of *Sasa jotanii* on Mt. Oyama, Mikurajima Island on Apr. 2, 1997 showing incanus whitish purple spikelets.

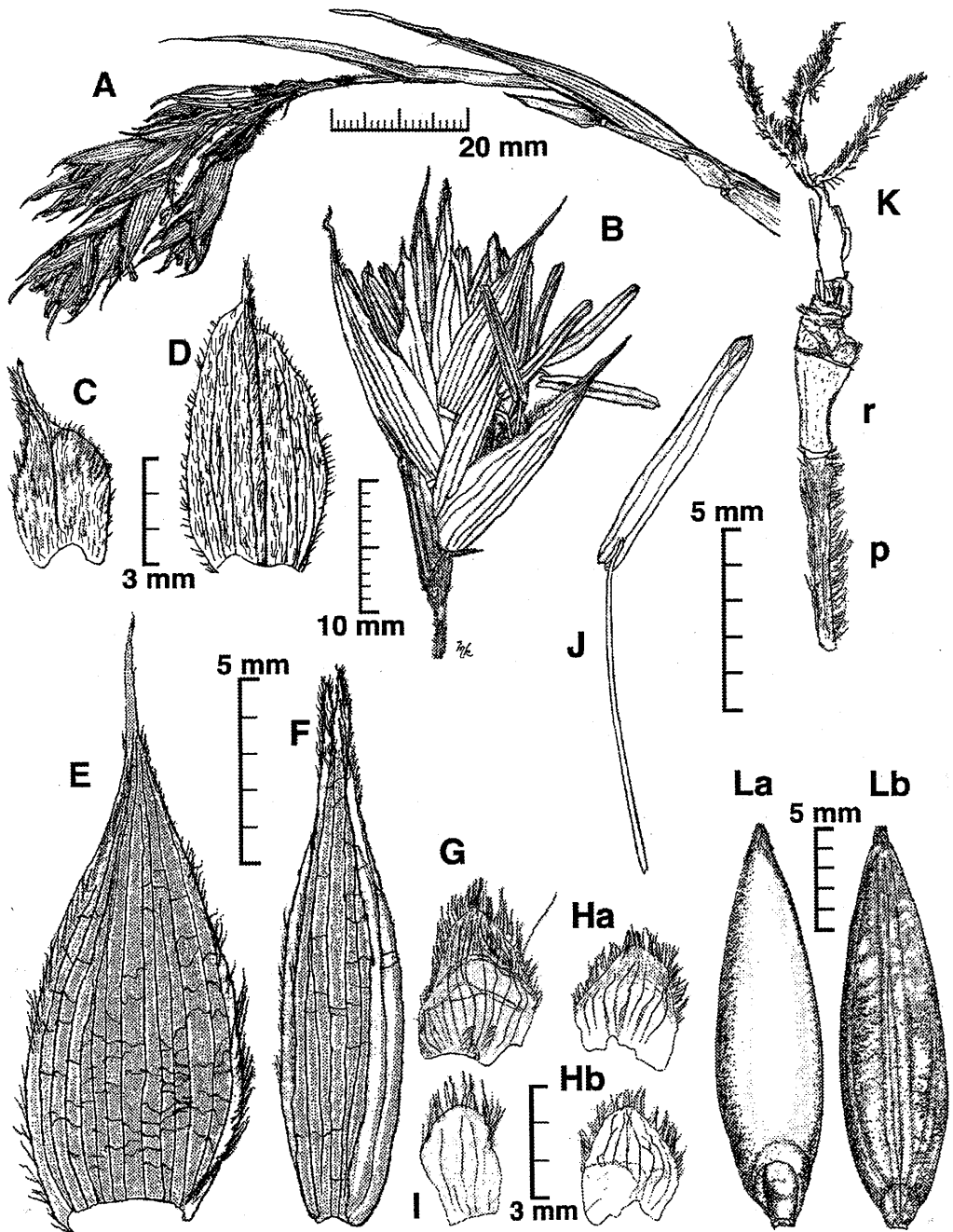


Fig. 2. *Sasa jotanii* (M. Kobayashi 1587). A. Flowering branch with a panicle. B. Spikelet. C. Glume I. D. Glume II. E. Lemma, abaxial view. F. Palea, adaxial view. G–H. Anterior lodicules, Ha: abaxial view, Hb: adaxial view showing fleshy part at the base. I. Posterior lodicule. J. Androecium. K. Gynoecium; r: Rachilla, p. Pedicel. L. Caryopsis; La. embryo side, Lb. hilum side.

Table 1. Comparison of diagnostic morphological features for *Sasa jotanii*, *S. kurilensis*, and *S. tsuboiana*

Character	<i>S. jotanii</i>	<i>S. kurilensis</i>	<i>S. tsuboiana</i>
Anterior lodicule length (mm)	3.8	2.4	2.1
Number of lemma nerves	13	7	7
Lemma length (mm)	21.8	7.9	8.4
Glume II length (mm)	16.5	4.2	3.6
Glume I length (mm)	8.7	1.6	0.7
Number of florets per spikelet	4	4–6	6–12
Rachilla length (mm)	4.9	3	5
Spikelet length $\times$ width (mm)	30.9 $\times$ 9.3	14.3 $\times$ 5.1	27.7 $\times$ 4.2
Spikelet shape	fusiform	fusiform	linear
Pedicel length (mm)	11	7.6	13
Caryopsis length (mm)	18.5	7.9	8

### Discussion

*Sasa jotanii* is named for its first collector Dr. Yukio Jotani, and is characterized by its less decumbent culms and thicker foliage leaves in sterile organs (Inoue and Tanimoto 1985); a large fusiform, incanus reddish-purple spikelet (31 mm long, 9 mm wide), extremely large elliptic caryopsis (18.5 mm long) with non-dormancy in reproductive organs (Figs. 1, 2 and Table 1). *Sasa jotanii* shares similarities with *S. kurilensis* and *S. tsuboiana*, and the three species are compared and contrasted in Table 1. *Sasa jotanii* develops an amphipodial rhizome system from two-year-old clump after germination through the final stage of flowering (Kobayashi and Tanimoto 1999). No phylogeny of *Sasa* exists, but *S. jotanii* falls within the genus *Sasa*, and is probably most closely related to *S. kurilensis* belonging to the section *Macrochlamys*. Although *S. jotanii* has one of the most distinctive features on caryopsis, i.e., non-dormant and the largest in the Japanese bamboos (Muramatsu 1998, Nishiwaki and Makita 1998).

Vegetatively, *S. jotanii* and *S. kurilensis* are similar in culm height, diameter and foliage leaf shape, lacking oral setae and sheath-margin fimbriae, whereas *S. tsuboiana* is less robust with oblong-lanceolate leaf blades with setiform, radiate oral setae, culm- and

foliage leaf-sheath fimbriae present. Although the distribution of hairs are usually valuable in distinguishing among the species of *Sasa* (Suzuki 1978), these three species share glabrous in all part of culm-sheath, foliage leaf-sheath and foliage-leaf blade. *Sasa jotanii* can, however, be distinguished from the other two species by its waxy textures all over the branch complements, coriaceous acuminedly lanceolate foliage leaf blade with less brightness of veins when held up to light. On the other hand, the panicle of *S. tsuboiana* is the widest and most open among those three taxa. The longer and linear spikelet of *S. tsuboiana* distinguishes it from the other two species, and *S. jotanii* has the longest glumes, lemma, and lodicules among all those three. *S. jotanii* has a number of lemma nerves 13, whereas 7 in the other two (Table 1).

### Taxonomic treatment

***Sasa jotanii*** (Ke.Inoue & Tanimoto) M. Kobay. stat. nov.

*S. kurilensis* (Rupr.) Makino & Shibata var. *jotanii* Ke.Inoue & Tanimoto in J. Jpn. Bot. **60**: 25 (1985).

*S. kurilensis* (Rupr.) Makino & Shibata in Bot. Mag. Tokyo **15**: 27 (1901) pro parte–*S. Suzuki* in J. Jpn. Bot. **18**: 297, pro parte; Illust. Jap. Bamb., rev. ed. 211 (1996), pro

minore parte.

Distribution. Endemic to Isls. Mikurajima and Hachijojima, Izu Islands, Japan; cloud zones and windy fields; alt. 590–851 m in Isl. Mikurajima, 430–660 m in Isl. Hachijojima.

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小林幹夫：ミクラザサ (イネ科：タケ亜科) の花の形態と種ランクへの変更

1997年春に伊豆諸島・御蔵島で起きたミクラザサ個体群の一斉開花・結実によって、それまで知られていなかった花や穎果の形態を詳細に観察する機会を得た。その検討結果に基づいてミクラザサをチシマザサの変種から独立種とするランクの変更を行った。

ミクラザサの花梗はやや抽出し、先端に数個の小穂をつける。小穂は紡錘形で長さ30.9 cm, 幅9.3 cm, 4個の小花からなり、先端の1個は痕跡的となる。第1および第2苞穎は全面を寝た毛で

覆われ、それぞれ8.7及び16.5 mmで5脈、13脈があり、先端は2–3 mmの芒状に尖る。第1小花の長さは22.8 mm, 外穎と内穎はそれぞれ21.8及び17.5 mmで外穎の先端は5–7 mmの芒状に尖り、内穎は2竜骨があり、上端が尖る。縁には絨毛状の長い毛があり、脈間は白色の寝た短毛で覆われ、赤紫色の小穂は全体に白っぽく見える。13脈があり脈間には格子状の横脈が走る。鱗被は3枚で外穎側の2枚はそれぞれ長さ3.8, 3.5 mm, 内穎側の一枚は2.5 mm, 先端は絨毛状の毛があり、

前2者の基部は肉厚に膨らむ。おしべは6本で赤紫色、めしべの柱頭は羽毛状に三叉し、螺旋を描く。穎果は長さ18.5 mmで先端の尖った長卵形で、休眠性を欠く。これらの結果をミクラザサと最も近縁と判断されるチシマザサおよびイブキザサに

ついて比較すると、ミクラザサは小穂の大きさ、鱗被、苞穎、外穎及び穎果の長さが他のいずれよりも飛び離れて大きく、独立の種として扱うのが妥当である。  
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